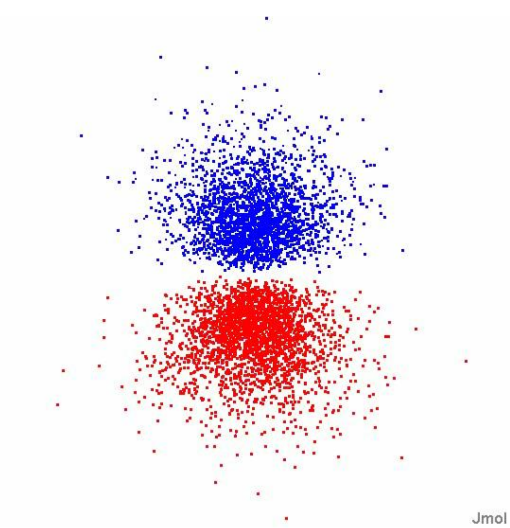
Response to the comments of Professor of Nuclear Physics, Plasma Physics, and Microelectronics at Moscow M.V. Lomonosov State University, A. M. Popov.

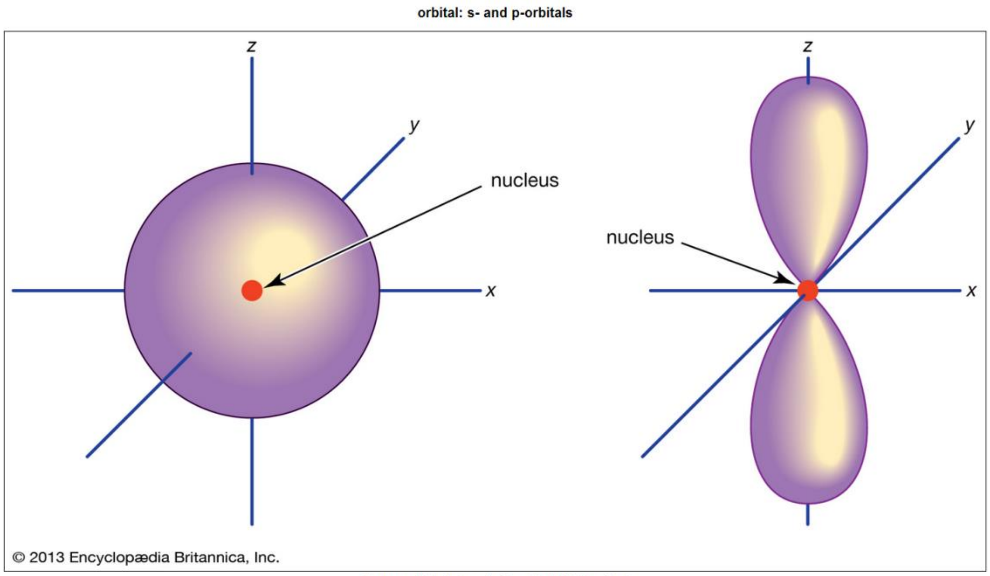
Finally, the ideas regarding the possible explanation of the effect of the so-called cold DD fusion in conductive crystals that were presented by me and my colleagues in the 2011 – 2014 publications reached my alma mater, Moscow M.V. Lomonosov University's Physics Department. The Faculty of Atomic Physics, Plasma Physics, and Microelectronics have commissioned Professor A.M. Popov to explain to me why these ideas are untrue.

With all of my respect to the Faculty of Atomic Physics, Plasma Physics, and Microelectronics at Moscow State University and to Professor A.M. Popov, I want to note that his main objection to the possibility of cold fusion is associated with his lack of understanding of the specifics of this process and conditions of conductive crystals. It should be noted that he was not alone in this lack of the understanding. This fact is the consequence of the inevitable narrow specialization of modern science, of its "domain" structure. As noted by Kozma Prutkov, a famous person in Russian literature, "Specialist is similar to gumboil: his fullness is one-sided."

In his review, Professor A.M. Popov writes: "E.N. Tsyganov approach to the justification of the possibility of the fusion reaction proceeding in deuterium dissolved in the crystal Pt (Pd) is in fact an attempt to justify the possibility of a significant decrease in the distance between deuterons by dissolving them in deuterium." If Professor A.M. Popov could pass a small square between the Physics Department and Chemistry Department at Moscow State University, he could easily find out that the state of the hydrogen atom ("for example, 2p") is as follows:



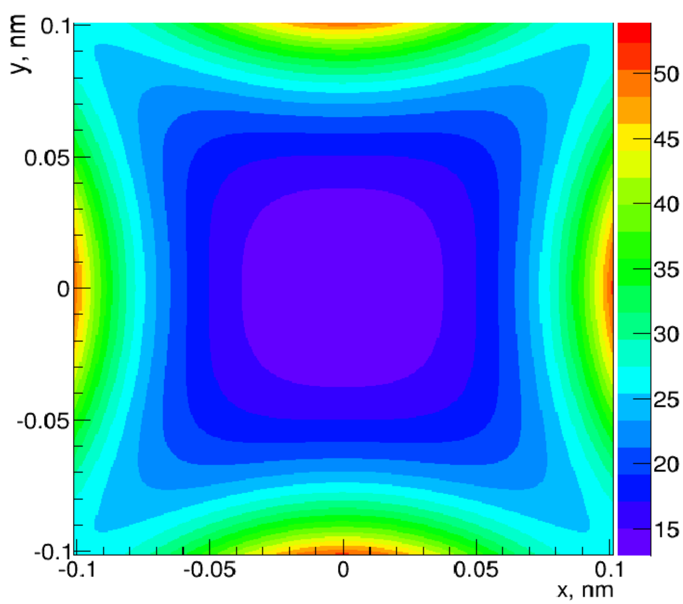
The figure is taken from the work of Dr. Winter, University of Sheffield, UK [1]. The nucleus in the figure of an atom in the ***2p*** orbital is placed between these two "electronic clusters." The concept of atomic orbitals has long entered the lexicon of both physics and chemistry. Here's how it has been illustrated in a recent issue of the Encyclopedia Britannica:



Electron orbitals in atoms (Left) *s* orbital; (right) *p* orbital
Encyclopædia Britannica, Inc.

In this figure, the left side shows a state of the hydrogen atom ***1s***, right - the hydrogen atom in a state of ***2p***. Contours limit of 95% of the "electron cloud" density. Of course, the Encyclopedia Britannica can be something to rebuke, but a sharp contrast between the states of ***1s*** and ***2p*** clearly demonstrated.

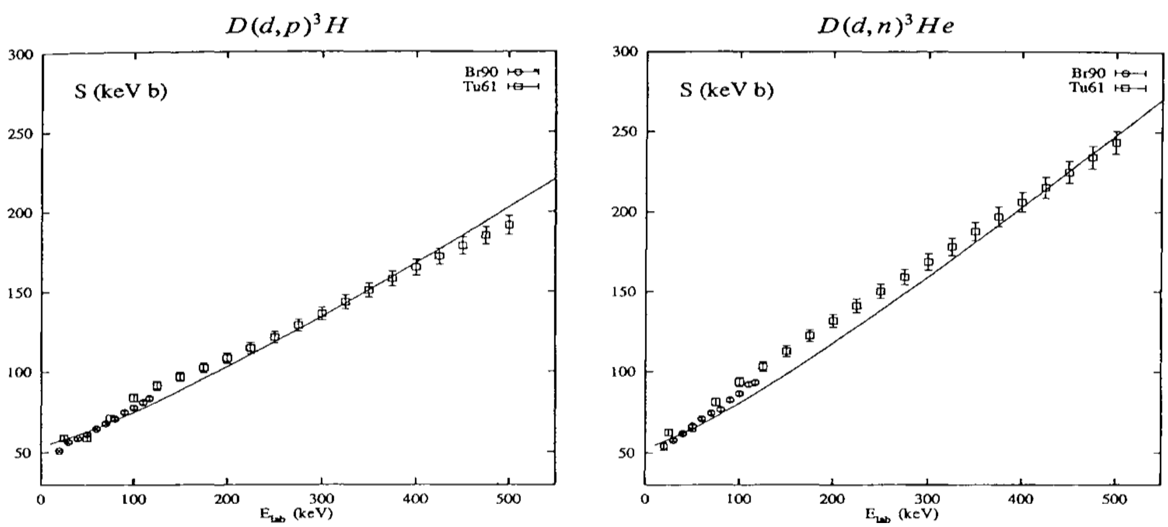
If Professor A.M. Popov would look to his colleagues in the Department of Crystallography, then he would see that the map of the electric fields in the central part of the crystallographic cell of platinum shows like this:



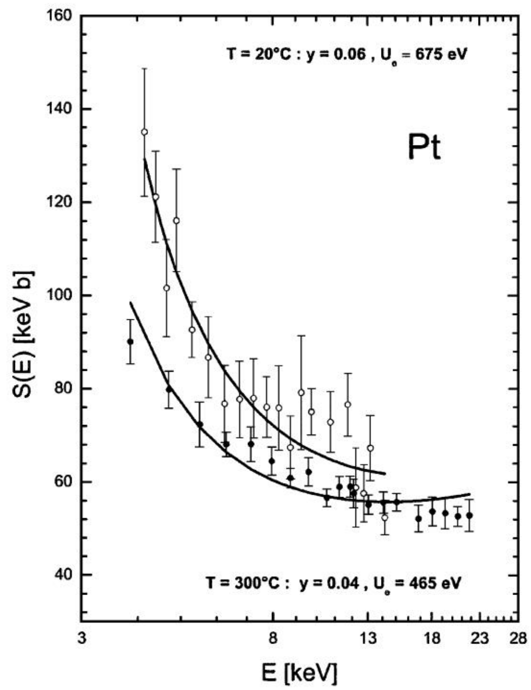
Here the vertical color scale on the right side shows the value of the electric potential in volts in this particular area of the platinum crystal cell. It is the central region of the crystallographic cell that concentrates on the so-called ***free conduction electrons*** of metal. The presence of them in this place leads to a sharp difference in the probability of DD-fusion reaction in the case, when the target particle implanted in metal crystals, from its design value. Professor A.M. Popov could ***draw attention*** to the fact that this sharp increase in the probability of DD-fusion in metals is not observed if the target atoms are in a free state in a condensed medium, or implanted in semiconductors, or insulators. Apparently, if these atoms are in their ground state ***1s,*** then the free electrons of the metal impose a ban on the possibility of "dissolution" of the hydrogen atoms in the metal. Similarly, the hydrogen atoms in the ***2p***-state easily "co-exist" with these free conduction electrons.

Although, unlike the cold fusion process, which is based on the quantum vibrations of the bound DD system and is very similar to the DDμ catalysis quoted by Professor A.M. Popov, penetration through the Coulomb barrier is realized in a ***single collision*** in accelerator experiments, tokomaks, and inertial fusion devices. It should be stressed here that dependent on the deuteron energy, the tunneling probability of deuterium through the Coulomb barrier is similar for all three cases.

The figure below shows the accelerator data on DD-fusion reactions in a wide range of energies. [2]



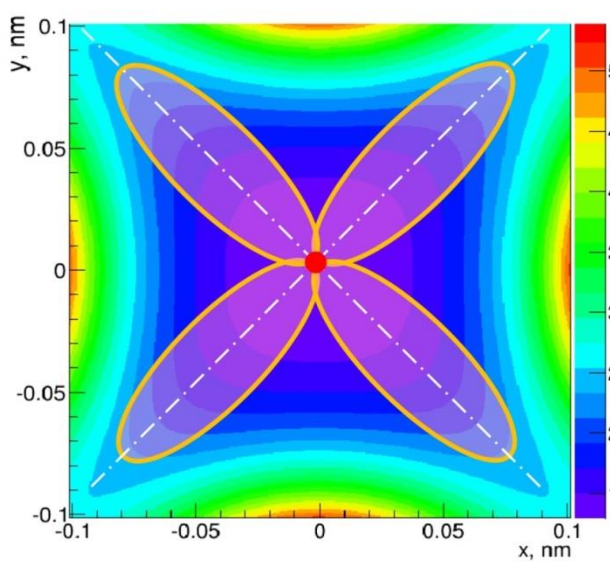
The following figure shows the behavior of the normalized astrophysical function *S(E)* in the case of DD-fusion to observe the reaction D+D→^{3}H+p at an acceleration of low energies in the collision of particles in the case where the target deuterium atoms are implanted in platinum [3]. Rather than approach to the limit of about 50 keV-barns, as this happens in the case of non-metals, the values of *S (E)* begin to increase sharply.



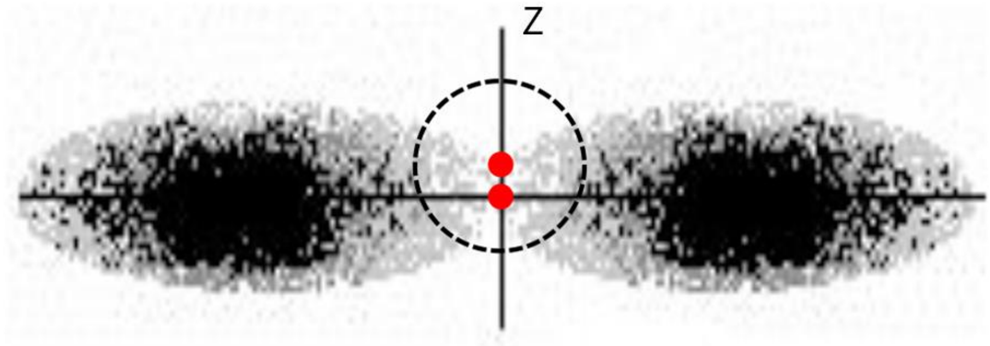
From the data it is evident that in the platinum both colliding deuterium atoms are in a state ***2p*** (or ***2p***+***3p***). The so-called effective screening radius of deuterium atoms in the platinum in this case is equal to 675 eV. According to Professor A.M. Popov, this can not be, "because it can never be."

The case when two atoms of deuterium in the ***2p*** state are in the same platinum crystallographic niche might look like as shown in the figures below [4]:

"Top" view:

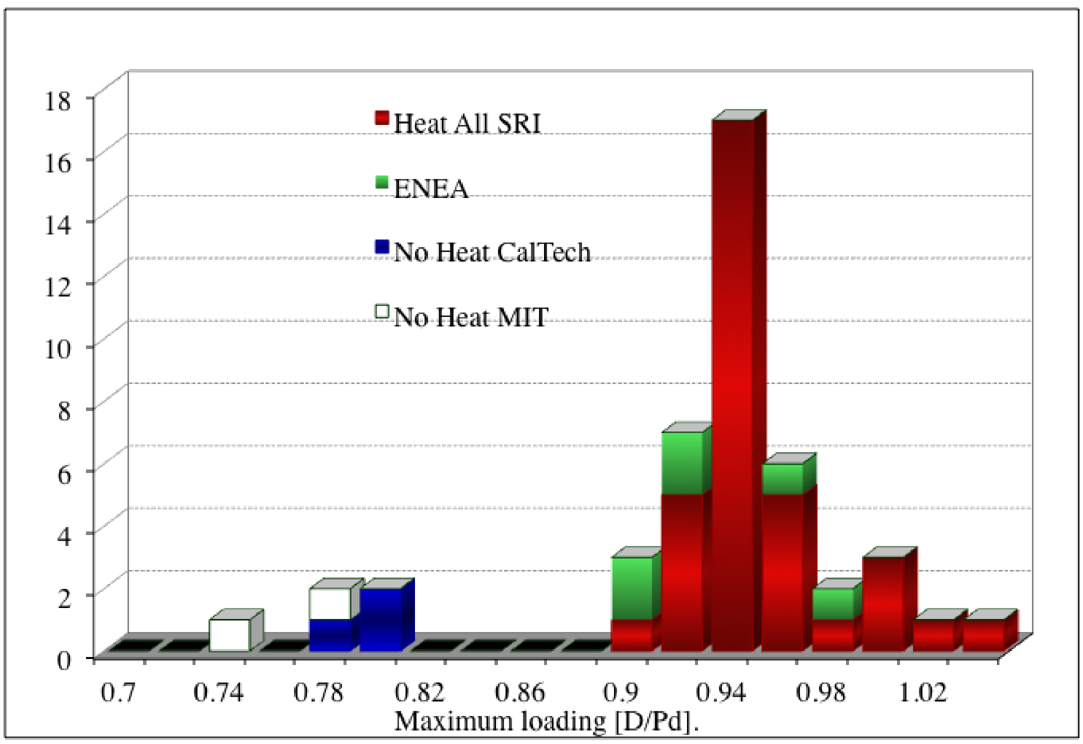


"Side" view (at 45° angle)

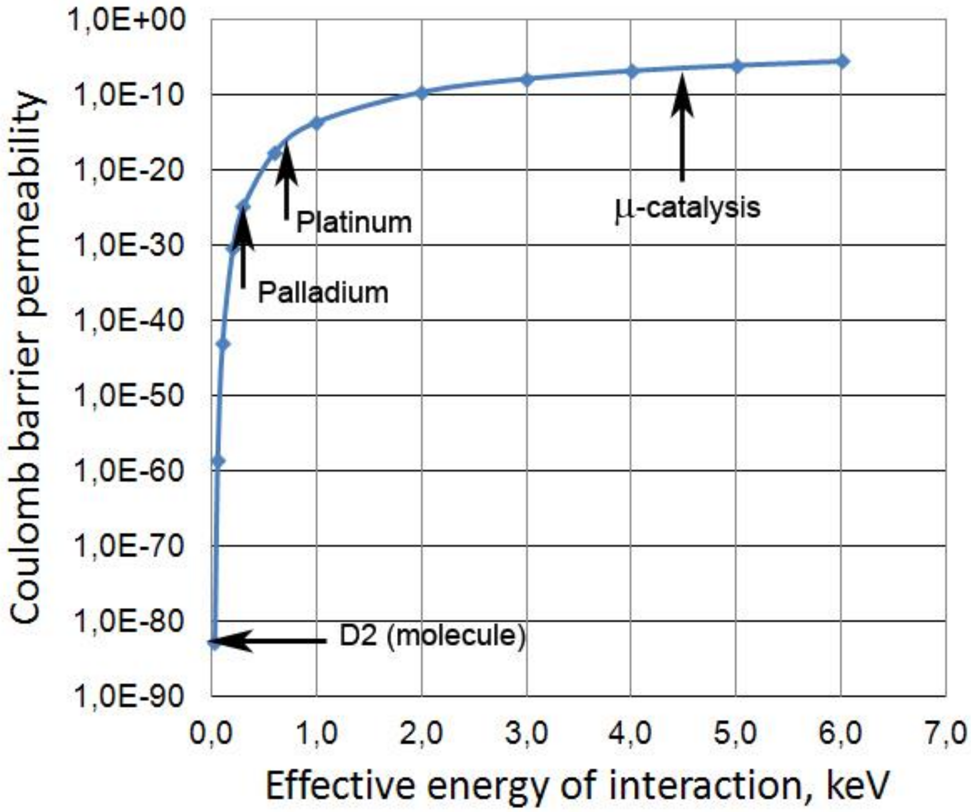


These types of configurations remain stable due to the electrical potential of the crystal within the corresponding "quantum vibration." Some readers will want to exclaim as Galileo: "And yet it moves! Eppur si muove!!" - But this is not the case, which is described in the legend. As a general rule, strict order in the crystal is well respected due to the inhomogeneity of electrical potentials in its lattice.

In the experiments of the McKubre (Stanford Research Institute, International), it was shown that the effect of cold fusion in conducting crystals was observed only when all of the most deep (octahedral) niches were already filled once with deuterium atoms [5]:



The first attempt to account the finite size of the deuterium atoms in the fusion reaction was carried out in Assenbaum et al. [6]. It was shown in this work that this effect for collision free atoms of deuterium can be taken into account by introducing additional energy of interaction U_e = 27 eV. Generalization of this approach shows that this is justified as long as the maximum amplitude of the potential barrier (about 200 keV) is much larger than the input correction. The measured value U_e of this correction 675 eV for platinum satisfies this condition. Below [4] a graph of the transparency of the Coulomb barrier *vs* the effective energy of interaction of the DD in c.m.s. is provided:



A very good proposal for a theoretical calculation process is done at the end of the letter from Professor A.M. Popov. However, in this proposal, Professor A.M. Popov forgot the ***main thing*** - the impact of free conduction electrons in metallic crystals to excite the orbitals of "dissolved" deuterium. It reminds me of I.A. Krylov fable, that says: "well, brother, do not blame me: the elephant I did not notice." In the jokes of the famous Russian actor: "careful, we must be careful." However, the possible attempts of Professor A.M. Popov to take into account for this effect would be very valuable. Even so-called ***"verbal speculation"*** would be appropriate here. It seems to us that the Department of Atomic Physics, Plasma Physics, and Microelectronics of Moscow M.V. Lomonosov State University could be the best place for such a calculation.

I would like to take this opportunity to draw attention to the recent success of A.G. Parkhomov, Ph.D. of Moscow M.V. Lomonosov State University in the field of cold nuclear fusion.

https://docviewer.yandex.com/?url=ya-disk-public%3A%2F%2FymuhQkXSD6eVmYUi1bHP87eU8G5wmG0yyk9iMhKEiyo%3D&name=29_01_2015_%D0%A0%D0%A3%D0%94%D0%9D_%D0%9F%D0%B0%D1%80%D1%85%D0%BE%D0%BC%D0%BE%D0%B2_%D0%90%D0%BD%D0%B0%D0%BB%D0%BE%D0%B3%D0%A0%D0%BE%D1%81%D1%81%D0%B83.pdf&c=54f283300f4e

http://my.mail.ru/mail/gopri/video/597/1504.html

http://vimeo.com/118323825

I would like to also draw attention to our discussions of the Andrea Rossi experiments in 2012:

http://www.coldfusion-power.com/uploads/7/3/6/7/7367632/5_proceedings__-2012_short_short.pdf

E. N. Tsyganov
Doctor of Physical and Mathematical Sciences, Professor
Laureate of the State Prize of the Russian Federation in the field of science and technology

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